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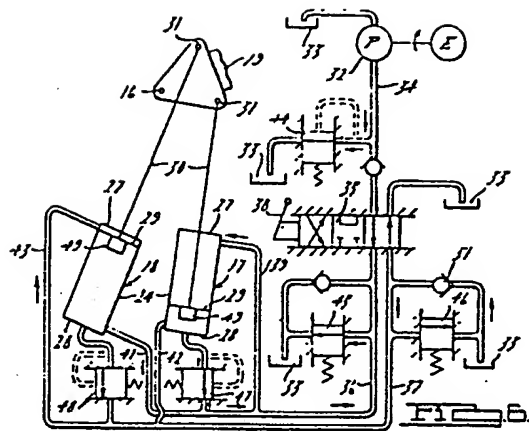
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(54) Swing post hydraulic circuit.

(57) An hydraulic system for actuating a swing-post mounted backhoe boom (19) comprises two double-acting hydraulic cylinders (17, 18) operated by a control valve (35). As the backhoe boom (19) swings into a swing stop, hydraulic fluid is trapped in the head end (28) of the swing side cylinder. This trapped fluid is discharged through a cylinder relief valve (47), thus absorbing the boom kinetic energy and providing a smooth deceleration of the boom. Fluid discharged from the relief valve (47) is routed to the rod end of the swing cylinder and the head end of the opposite cylinder. Because of the swing linkage geometry, the cylinder rod (30) of the other cylinder had passed over the pivot axis (16) about which the backhoe boom (19) was swinging and thus the piston (29) of the other cylinder was caused to move in the same direction as the swing side piston (29). The movement of this piston can be utilized to provide additional deceleration torque as long as no void-

ing is permitted to occur in the head end of this other cylinder. Voiding only occurs when the backhoe swing control lever (38) is released prior to the backhoe boom reaching the swing stop. Voiding does not occur when the control lever (38) is maintained in a full power-on or is stroked in the power-on mode until the swing stop is contacted. Fluid from the swing side cylinder relief valve is routed to provide the necessary fluid to prevent such voiding. The routing of the fluid from the swing cylinder to the other cylinder assures that the boom deceleration is independent of whether the control lever is stroked or released.

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EUROPEAN PATENT CONVENTION

SPECIFICATION

TITLE

SWING POST HYDRAULIC CIRCUIT

DESCRIPTION

1 This invention relates to hydraulic circuits for swing posts.

5 In a conventional earth moving machine having an earth digging implement mounted on one end, usually the rear end, the implement, herein referred to as the backhoe, is mounted on a swing post or mast that is supported on the vehicle frame for swinging movement about a vertical axis. The backhoe is swingable from one side to the other of the vehicle about the vertical axis to facilitate the trenching, ditching or other digging operations. 10 The swinging movement is actuated by a pair of pivotally supported hydraulic actuators extending between the vehicle frame structure and the mast or swing post.

One of the earliest patents disclosing a commercially acceptable system for actuating a swing post or mast mounted 15 bucket is United States Patent Specification No. 3,047,171. One feature covered by this patent is that of providing a hydraulic "buffer" or cushioning arrangement that functions to decelerate the rotation or swing of the swing post or mast of the backhoe just prior to the end of its swing. This is accomplished by a 20 dual hydraulic cylinder arrangement in which movement of one of the cylinders over centre causes reverse movement of its piston creating a back pressure to check swinging of the swing post or mast. In order to absorb the pressure surge caused by such cushioning, the hydraulic system is provided with a relief valve, 25 the excess pressure fluid being discharged ultimately into the fluid supply reservoir or tank. The hydraulic system also includes directional control valve means for routing fluid under pressure to one or the other of the cylinders, depending on the direction it is desired to swing the backhoe boom.

30 It apparently was the opinion of persons subsequently active in the development of backhoe control devices that more positive braking or cushioning devices than pressure relief valves were required to control the momentum forces of the heavy backhoe

1 mast and swing units as the end of the swing movement was  
approached. Reference may be made to U.S. Patent Specifications  
Nos. 3,630,120 and 3,815,766. These patents disclose sequence  
valve means for sensing the position of the hydraulic motors or  
5 actuators and for directing the flow of fluid to aid in obtaining  
a relatively constant torque output and angular velocity, bleeder  
valve means for reducing hydraulic input energy when the pivotal  
member (mast or swing post) is near the end of its rotation and  
for maintaining a maximum velocity potential throughout the swing  
10 movement, and relief valve means for additionally controlling  
torque output. The function of such valve systems is to provide  
a positive braking or cushioning action not found in the earlier  
systems, but the result is a valve system believed to be of  
unnecessary complexity for the benefits derived.

15 According to the present invention, there is provided an  
hydraulic system for actuating a swing-post mounted backhoe  
comprising two double acting hydraulic cylinders arranged on  
opposite sides of the swing post for swinging the back hoe in  
opposite directions, an hydraulic circuit for selectively direct-  
20 ing hydraulic fluid to the said cylinders to cause one cylinder  
to extend whilst the other retracts, and flow control means  
associated with the cylinders for reducing the rate of discharge  
of hydraulic fluid from one cylinder as the backhoe approaches the  
end of its movement characterised in that the flow control means  
25 directs fluid discharged from the said one cylinder to the other  
cylinder to oppose the movement thereof and to prevent voiding  
therein.

In a preferred embodiment of the present invention the  
swing post being mounted on a vehicle for swinging movement about  
30 a vertical axis and is operated by an hydraulic system which  
includes a pair of double-acting hydraulic actuators, each of  
which has a cylinder that is pivotally mounted on a support frame  
of the vehicle, double acting piston means within the cylinder,  
and a piston rod extending from the piston means through the rod  
35 end of the cylinder to the swing post. The piston rods are

1 pivotally coupled to the swing post on opposite sides of the  
vertical pivot axis about which the swing post is swingable.

The preferred hydraulic system embodies a hydraulic  
circuit including a source of pressurized fluid connected to each  
5 actuator by a first conduit means communicating with the rod end  
of one actuator and the head end of the other actuator; and a  
second conduit means communicating with the head end of one  
actuator and the rod end of the other actuator. Fluid flow into  
the system is controlled by a control valve means having an  
10 operating member movable from a neutral position to an actuator  
operating position in which fluid is directed through a predeter-  
mined one of a conduit means to the rod end of one of the actuator  
cylinders and to the head end of the other actuator cylinder to  
cause the swing post to swing in a predetermined direction. The  
15 pressure of the fluid acting on the actuator cylinders causes the  
piston end of one actuator cylinder to move from the rod end to-  
ward the head end. Simultaneously, the piston of the other  
cylinder is caused to move from the head end toward the rod end  
until the other cylinder piston rod crosses over the swing post  
20 pivot axis to the same side of the latter as the piston rod of the  
one actuator cylinder. As a result of this over-centre movement,  
the direction of movement of the piston of the other cylinder  
reverses and both pistons move from the rod ends toward the head  
ends of their respective cylinders. The system also includes a  
25 cutoff means operative to prevent discharge of fluid from the head  
end of the one actuator cylinder as the swing post approaches a  
predetermined position relative to the end of its side swing  
movement.

Relief means is provided for by-passing the cutoff means  
30 to permit controlled discharge of fluid trapped in the one  
actuator cylinder head end to cushion the deceleration of the  
swing post. The fluid from the relief means is routed through  
the one conduit means to the head end of the other cylinder, where-  
by the other cylinder provides additional deceleration torque as  
35 long as no voiding occurs therein in the event the control valve



1 means operating member is returned to a neutral position before  
the swing post reaches the end of its side movement. The fluid  
supplied from the head end of the one actuator cylinder provides  
the necessary volume of fluid to the other cylinder to prevent  
5 such voiding from occurring.

A preferred embodiment of the invention will now be  
described by way of example only, with reference to the drawings  
in which:

Figure 1 is a perspective view of a portion of an earth  
10 moving machine having a mast or swing post mounted backhoe on one  
end of the vehicle, the mast or swing post being shown in a  
centred position;

Figure 2 is a side elevation of a hydraulic actuator  
showing its relationship to the mast or swing post;

15 Figure 3 is a view taken substantially in the direction  
of the arrows 3-3 in Figure 2;

Figures 4, 5 and 6 are diagrammatic views of the hydraulic  
circuit showing the swing post in a sequence of positions  
beginning in the neutral or centred position and then ending up in  
20 a decelerating mode with full power on as the swing post swing  
stop is approached;

Figures 7 and 8 are diagrammatic views of the hydraulic  
circuit in an operating mode in which the swing post has been  
swung over centre and the power to the actuators has been released  
25 by return of the control lever of the control valve to a neutral  
position, the momentum of the boom continuing the movement of the  
swing post toward the swing stop; and

Figure 9 is a diagrammatic view of a second embodiment of  
the present invention in which the cylinder relief valves are  
30 integrated with the hydraulic actuator pistons, rather than being  
integrated with the head end of the cylinders, as shown in  
Figures 4-8, inclusive.

Referring now to the drawings, and more particularly to  
Figures 1, 2 and 3, there is partially shown one end of an earth  
35 moving machine, generally designated 10, adapted to have an earth

1 circuitry for controlling and motivating the hydraulic actuators  
17-18 includes a source of fluid under pressure comprising an  
engine driven pump 32 adapted to draw hydraulic fluid from a tank  
or reservoir 33 and to discharge the fluid of predetermined  
5 pressure and discharge rate into a conduit 34 in communication  
with a control valve 35 operable to direct the pressurized fluid  
into a first conduit 36 or a second conduit 37. The control valve  
35 is operated by a control valve lever 38, and depending on the  
operator's manipulation of this lever, the swing post or mast 15  
10 and the boom mounted thereon may be swung in either a clockwise or  
a counter-clockwise direction, as viewed in Figure 4. For the  
purpose of this description, it will be assumed the operator  
desires to swing the swing post or mast 15 in a clockwise direction.  
Accordingly, the control valve will be operated to direct pressur-  
15 ized fluid into conduit 36 and the conduit 37 then becomes the  
return line for the fluid in the system.

The conduit means 36 has a first branch 39 in communica-  
tion with the rod end 27 of the hydraulic actuator 17 and a  
second branch 41 in communication with the head end 28 of the  
20 hydraulic actuator 18. The second conduit 37 has a first branch  
42 in communication with the head end 28 of the hydraulic actuator  
17 and a second branch 43 in communication with the rod end 27 of  
the actuator 18. This is conventional practice in the use of dual  
hydraulic actuators in backhoes and hydraulic steering systems for  
25 articulated vehicles or for the landing gear of aircraft. With  
this arrangement, the swing side actuator, the one on the side of  
the swing post pivot axis toward which the swing post is moving, is  
assisted by the other actuator, as will be more fully explained.  
Since, for the purposes of explanation, it is being assumed the  
30 swing post 15 is swinging in a clockwise direction toward the  
hydraulic actuator 17, the latter will hereinafter on occasion be  
referred to as the swing side actuator and the actuator 18 as the  
other side actuator.

A plurality of relief valves and check valves are shown.  
35 For example, a system relief valve 44 is shown between the pump

1 32 and the control valve 35 which has the function of relieving  
pressure on the discharge side of the pump when there is no flow  
through the control valve. Each conduit 36 and 37 is provided  
with a circuit relief valve 45 and 46, respectively, to relieve  
5 pressure in these conduits should it be necessary.

In addition to the relief valves 44, 45 and 46, the  
hydraulic system embodying the present invention utilizes two  
additional relief valves 47 and 48. These valves are physically  
integrated in the head ends 28 of the cylinders 24 of the hydraul-  
10 ic actuators 17 and 18, respectively. The valves 47 and 48 are  
adapted through suitable conduits to communicate the head ends of  
the cylinders 24 of the actuators 17 and 18 directly with the  
conduits 36 and 37, respectively, for functional purposes to be  
explained.

15 As has been stated, the swing post or mast 15 carrying  
the boom 19 is shown in a neutral or centred position and the  
assumption is that the backhoe operator is to swing the same in a  
clockwise direction. This is accomplished by moving the control  
lever 38 of the control valve 35 in a direction to permit fluid  
20 flow from the pump 32 to the conduit 36. Fluid under pressure  
will flow through the conduit 36 through its branch 39 to the rod  
end 27 of the swing cylinder 24, in the present instance the cyl-  
inder of the hydraulic actuator 17. Fluid will flow simultane-  
ously through conduit 36, branch 41, to the head end 28 of the other  
25 cylinder 24, the cylinder of the hydraulic actuator 18. The  
result of the fluid pressure being exerted on the rod end side of  
the piston 29 of the hydraulic actuator 17 causes this piston to  
move toward the head end of its cylinder. This retracts the swing  
side piston rod 30 into the swing side cylinder and pulls the  
30 swing post 15 in the desired clockwise direction. This movement  
is being assisted by the hydraulic actuator 18 which is receiving  
fluid into the head end of its cylinder, thereby causing movement  
of its piston towards the head end and extension of its piston rod  
outwardly to exert a pushing force in a clockwise direction on the  
35 swing post 15. Because of the geometry of the system, the swing

1    sid piston and the piston rod coupled to it begin to move rapidly  
2    toward the head end of the swing cylinder, while the piston and  
3    piston rod of the other cylinder are moving very slowly since the  
4    piston has only a short distance to go before reaching the rod end  
5    of the other cylinder.

6    During the movement of the swing cylinder piston toward  
7    the head end 28 of the cylinder of the hydraulic actuator 17,  
8    fluid is being discharged from the head end through the branch  
9    42 of the conduit 37. Fluid simultaneously is being discharged  
10   from the head end of the cylinder of the hydraulic actuator 18 into  
11   the branch conduit 43. The fluid from the branches 42 and 43 are  
12   then discharged through the conduit 37 and the control valve 35  
13   back to the tank or reservoir 33.

14   Figure 5 diagrammatically illustrates a further phase of  
15   the power-on swinging movement of the swing post. By power-on  
16   is meant that the control lever 38 is in a position so that the  
17   fluid under pressure from the pump 32 is being directed into the  
18   conduit 36 through the control valve 35. In the further phase,  
19   the piston 29 of the hydraulic actuator 17 is rapidly moving to-  
20   ward the head end of its cylinder. The piston 29 of the hydraulic  
21   actuator 18 which had been moving toward the rod end of its cyl-  
22   inder reverses its direction of movement as its piston rod 30  
23   crosses over the pivot axis 16 of the swing post. That is, the  
24   piston 29 begins to move toward the head end 28 of the cylinder  
25   24 of the hydraulic actuator 18.

26   As the piston 29 of the hydraulic actuator 17 approaches  
27   the end of its movement towards the head end of its cylinder, a  
28   cut-off means comes into play. This cut-off means is diagrammatic-  
29   ally shown as a projection 49 beneath the piston which represents  
30   a plunger that plugs the exhaust line leading from the head end of  
31   the cylinder. This is conventional practice for this type of  
32   hydraulic cylinder mechanism and in the present instance would  
33   result in the inlet to the conduit 42 being blocked so that fluid  
34   cannot flow through the conduit 42 into the return line 37.

35   With reference to Figure 6, this then becomes the

1 concluding or deceleration phase of the power-on movement of the  
swing post. The blockage of the discharge from the head end of  
the hydraulic actuator 17 occurs approximately twenty degrees  
5 before the swing post reaches a point at which it is mechanically  
stopped by abutting a swing stop. As a result of the momentum of  
the swing post because of its weight and the weight of the boom,  
swing post movement continues during the last twenty degrees caus-  
ing a pressure build-up to occur in the head end of the hydraulic  
10 actuator 17. At a predetermined point or pressure build-up, the  
cylinder relief valve 47 opens to relieve this pressure and to  
permit a controlled deceleration of the swing post. This control-  
led deceleration preferably should be assisted by the resistance  
to movement of the piston of the hydraulic actuator 18 toward the  
head end of the cylinder of the latter.

15 When the relief valve 47 opens, there is a reversal of  
flow of fluid in the conduit 36 and its branch conduit 41. Some  
of the fluid from the head end of the cylinder 24 of the hydraulic  
actuator 18 and from the head end of the cylinder 24 of the  
hydraulic actuator 17 will attempt to flow through the conduit 39  
20 into the rod end of the cylinder 24 of the hydraulic actuator 17,  
but the volume demand of this cylinder will be drastically cut  
since the movement of the piston rapidly slows down as the end of  
the swing of the swing post is approached. Accordingly, excess  
fluid from the head ends of the respective cylinders and fluid  
25 coming from the control valve will be discharged through the  
circuit relief valve 45 where it will be returned to the tank or  
reservoir 33. Since the piston 29 of the cylinder 24 of the  
hydraulic actuator 18 is moving away from its rod end, it will  
create a suction on the system, particularly on the branch conduit  
30 43 of the conduit 37. This suction may result in fluid being  
drawn from the tank or reservoir 33 through the control valve 35.

Preferably, the backhoe operator should stroke or fully  
return the control lever 38 toward its neutral position during the  
period in which the fluid from the head end of the swing cylinder  
35 is blocked from discharging into the return line 37, thus providing

1 a controlled deceleration as the swing post approaches the end of  
its stroke. But, even if the operator maintains full power-on to  
the end of the stroke, the present system permits adequate fluid  
deceleration because of the co-action between the two hydraulic  
5 actuator cylinders 17 and 18.

The present system differs from earlier known systems in  
that the cylinder relief valve 47 does not discharge directly to  
a sump. Instead, it discharges into the line that had been  
supplying fluid to the rod end of the cylinder 24 of the hydraulic  
10 actuator 17. Because of this arrangement, the co-action between  
the two hydraulic actuators to decelerate the swing post as it  
moves toward its swing stop cannot be disrupted by premature  
return of the control lever 38 to its neutral position, even  
though the movement of the swing post and the boom have not been  
15 stopped and the movement of the piston continues as a result of  
the momentum of the swing post and boom. Reference is made to  
Figures 7 and 8 for a more detailed explanation of this feature of  
the present invention.

Figure 7 is substantially a physical duplicate of Figure  
20 5 in that it shows the swing post 15 in a position in which the  
piston rod 30 of the hydraulic actuator 18 has just crossed over  
the pivot axis 16 of the swing post. Since it is now assumed,  
however, that the backhoe operator has released the control lever  
38 which has returned to a neutral position cutting off the flow  
25 of fluid under pressure from the pump 32 through the control valve  
35, and, further, that the momentum of the boom 19 and swing post  
15 causes the latter to continue to swing in a clockwise direction  
toward the swing stop, the fluid flow conditions within the system  
on the discharge side of the control valve 35 are substantially  
30 different in Figure 7 from that related with respect to Figure 5.

The momentum of the swing post 15 and boom 19 drives the  
piston 29 and piston rod 30 of the hydraulic actuator 17 from the  
rod end toward the head end of the cylinder 24 of the hydraulic  
actuator 17. As the piston 29 moves toward the head end, it  
35 creates a suction on the branch 39 of conduit 36. Although the

1 piston 29 of the hydraulic actuator 18 now is moving from the rod  
end toward the head end of the cylinder 24 of the hydraulic act-  
uator 18, its rate of movement is substantially slower than that  
of the piston 29 of the hydraulic actuator 17. The result of the  
5 disparity of movement of the pistons in the hydraulic actuators  
17 and 18 is such that the piston in the hydraulic actuator 17  
functions as a pump pulling fluid from the head end of the  
hydraulic actuator 18 through the branch conduit 41 and also from  
the tank or reservoir 33 through the check valve 52 in communica-  
10 tion with the conduit 36.

While the foregoing is occurring, fluid is being dis-  
charged from the head end of the hydraulic actuator 17 cylinder  
through the branch line 42 of the conduit 37. Some of this fluid  
is being supplied to the conduit 43 leading to the rod end of the  
15 hydraulic actuator 18 cylinder. The quantity of fluid required to  
fill the void in the rod end of the hydraulic actuator 18 cylinder  
above the slowly moving piston 29 of the latter, is much less than  
that being discharged from the hydraulic actuator 17 cylinder.  
Therefore, the remainder of the discharge fluid flows through the  
20 conduit 37 through the circuit relief valve 46 back to the tank or  
reservoir 33. It should be apparent, however, that a condition  
now is occurring in the head end of the hydraulic actuator 18  
cylinder which would cause a void in the latter. This void, if  
permitted to exist, could have a negative effect on the ability of  
25 the system to provide the desired deceleration torque as the swing  
post and boom approach the end of their travel.

In the present system, fluid from the swing side cylinder,  
the cylinder of the hydraulic actuator 17, provides the necessary  
fluid to prevent voiding in the head end of the other cylinder,  
30 i.e., the cylinder of the hydraulic actuator 18. Reference is  
made to Figure 8 for the manner in which this is accomplished.

Figure 8 corresponds physically to Figure 6 in that the  
swing side cylinder piston 29 is indicated as having reached the  
point in its travel from the rod end to the head end of the  
35 cylinder 24 of the hydraulic actuator 17 in which discharge from

1 the head end is cut off by the cut-off means diagrammatically  
illustrated at 49. The result is that the pressure in the head  
end of the hydraulic actuator 17 cylinder builds up to a point at  
which the relief valve 47 is forced to open and to discharge high  
5 pressure fluid into the conduit 36. Some of this high pressure  
fluid will flow through the branch conduit 41 to the head end of  
the hydraulic actuator 18 cylinder, thus preventing the undesirable  
occurrence of a void in the cylinder. Some of the fluid in the  
conduit 36 will flow to the branch conduit 39 into the rod end of  
10 the hydraulic actuator 17 cylinder. All excess fluid in the  
conduit 36 has an outlet through the circuit relief valve 45 from  
which it can return to the tank or reservoir 33.

The downward movement of the piston 29 of the hydraulic  
actuator 18 will place the branch 43 of the conduit 37 under  
15 suction and since no fluid is available from branch 42 leading to  
the discharge side of the hydraulic actuator 17 cylinder, make-up  
fluid will be obtained through the check valve 51 in communication  
with the conduit 37 and the tank or reservoir 33.

The reason that voiding did not occur in the hydraulic  
20 actuator 18 cylinder under the Figure 5 conditions of operation,  
i.e., the conditions when the swing post and boom are moved toward  
the swing stop under power, as occurs when the control lever 38  
is held in an on position or is stroked toward the on position, is  
that the pressure in the conduit 36 is sufficient to reverse the  
25 flow in the conduit branch 41 in the event that there is any  
tendency for voiding to occur in the hydraulic actuator 18 cylinder.  
For this reason, the flow arrows in Figure 5 are shown as indicat-  
ing fluid flowing in either direction. Under Figure 8 conditions,  
however, if the relief valve 47 discharged into a conduit leading  
30 back to the tank or reservoir 33, as in earlier conventional  
systems, the only direction that fluid could flow from the hydraul-  
ic actuator 18 cylinder would be in a discharge direction from the  
head end of the cylinder. This would create the undesired voiding  
problem and would reduce the effectiveness of the hydraulic  
35 actuator 18 to assist in providing the desired deceleration torque.



1           It should be understood, that if the swing post movement  
was originally started in a counter-clockwise direction, the roles  
played by the hydraulic actuators 17 and 18 would be reversed.  
The hydraulic actuator 18 would become the active actuator and the  
5   hydraulic actuator 17 would become what might be considered the  
passive actuator. The resultant flow of fluid through the system  
would be a mirror image of that which has been described on the  
basis of clockwise movement of the swing post and boom.

Figure 9 of the drawings illustrates the modification in  
10   which the relief valves corresponding to the relief valves 47 and  
48 of the previously described embodiment are integrated with the  
pistons 29, rather than being located in or coupled to the head  
end of the cylinder 24 of each hydraulic actuator. This construc-  
tion and arrangement also is effective to prevent voiding in the  
15   hydraulic actuator opposite the swing side hydraulic actuator. For  
example, if the swing side hydraulic actuator is the hydraulic  
actuator 17 as in the previously described embodiment, the voiding  
that might occur in the hydraulic actuator 18 as a result of the  
control lever 38 being released prior to the backhoe boom reaching  
20   the swing stop is automatically compensated. To illustrate, if  
the piston in the hydraulic actuator 17 cylinder approaches the  
head end of the cylinder so as to permit the cut-off device 49  
to become operative to cut off discharge of fluid from the  
head end into the branch conduit 42, the pressure in the head end  
25   will build up to a point that the relief valve 47 will open,  
permitting flow through the piston into the rod end of the hydraul-  
ic actuator 17 cylinder. The fluid then will flow from the rod  
end of the cylinder into the branch conduit 39, into the conduit  
36 and ultimately the branch conduit 41, thereby supplying fluid  
30   to the head end of the hydraulic actuator 18 cylinder and prevent-  
ing any voiding from occurring in the latter that would otherwise  
result if no fluid was being supplied to the rod end of the  
hydraulic actuator 17 cylinder.

It is to be understood this invention is not limited to  
35   the exact constructions illustrated and described above, but that

- 1 various changes and modifications may be made without departing from the spirit of the invention.

CLAIMS

1           1. An hydraulic system for actuating a swing-post  
              comprising two double acting hydraulic cylinders  
arranged on opposite sides of the swing post for swinging the  
backhoe in opposite directions, an hydraulic circuit for select-  
ively directing hydraulic fluid to the said cylinders to cause  
one cylinder to extend whilst the other retracts, and flow  
control means associated with the cylinders for reducing the rate  
of discharge of hydraulic fluid from one cylinder as the backhoe  
approaches the end of its movement characterised in that the flow  
10 control means directs fluid discharged from the said one cylinder  
to the other cylinder to oppose the movement thereof and to  
prevent voiding therein.

              2. An hydraulic system for actuating a swing post  
mounted backhoe,  
15           the swing post being mounted on a vehicle for swinging  
movement about a vertical axis,  
              the hydraulic system including a pair of double acting  
hydraulic actuators each of which has a cylinder that is pivotally  
mounted on a support frame of the vehicle, double acting piston  
20 means within the cylinder, and a piston rod extending from the  
piston means through the rod end of the cylinder to the swing  
post,  
              the piston rods being pivotally coupled to the swing  
post on opposite sides of the vertical pivot axis about which the  
25 swing post is swingable,  
              an hydraulic circuit including a source of pressurized  
fluid connected to each actuator by a first conduit means commu-  
nicating with the rod end of one actuator and the head end of the  
other actuator, and a second conduit means communicating with the  
30 head end of the one actuator and the rod end of the other actuator,  
              control valve means having an operating member movable  
from a neutral position to an actuator operating position in which  
fluid is directed through a predetermined one of the conduit means

1 to the rod end of one of the actuator cylinders and to the head  
end of the other actuator cylinder to cause the swing post to  
swing in a predetermined direction,

the pressure of the fluid acting on the actuator  
5 cylinder to move from the rod end toward the head end and the  
piston of the other cylinder to move from the head end toward the  
rod end until the other cylinder piston rod crosses over the swing  
post pivot axis to the same side of the latter as the piston rod  
of the one actuator cylinder whereupon the direction of movement  
10 of the piston of the other cylinder reverses and both pistons move  
from the rod ends toward the head ends of their respective cylinders,

and cut-off means operative to prevent discharge of fluid  
from the head end of the one actuator cylinder as the swing post  
15 approaches a predetermined position relative to the end of its  
side swing movement,

wherein the improvement comprises:

relief means bypassing the cut-off means to permit controlled  
discharge of fluid trapped in the one actuator cylinder  
20 head end to cushion the deceleration of the swing post,

the fluid from the relief means being routed through the  
one conduit means to the head end of the other cylinder whereby  
the other cylinder provides additional deceleration torque as long  
as no voiding occurs therein in the event the control valve means  
25 operating member is returned to a neutral position before the swing  
post reaches the end of its side movement,

the fluid from the head end of the one actuator cylinder  
providing the necessary volume of fluid to the other cylinder to  
prevent voiding.

30 3. An hydraulic system for actuating a swing post  
supporting a backhoe boom on a vehicle for swinging movement about  
a vertical pivot axis, comprising:

a dual hydraulic actuator means for swinging the swing  
post and thereby the boom mounted thereon to one side or the other  
35 of the vehicle toward respective swing stops,

1 each actuator means having a cylinder pivotally mounted  
on a frame member of the vehicle, a piston within the cylinder,  
and piston rod means extending from the cylinder and pivotally  
coupled to the swing post,

5 the piston rod means extending longitudinally of the  
vehicle and lying on opposite sides of the pivot axis of the  
swing post when the boom is positioned centrally of the vehicle,

conduit means communicating the rod end of each cylinder  
with the head end of the other cylinder,

10 a source of fluid under pressure,

and control valve means having an operating member  
movable from a neutral position for directing the fluid through  
the conduit means simultaneously to the rod end of the swing side  
cylinder, i.e., the cylinder on the side of the swing post pivot  
15 axis toward which the boom is to be swung, and to the head end of  
the other cylinder,

the fluid pressure causing the swing side cylinder  
piston to move from the rod end toward the head end of the swing  
side cylinder, and the opposite cylinder piston to move from the  
20 head end toward the rod end of the opposite cylinder until the  
opposite cylinder piston rod crosses over the swing post pivot  
axis whereby the direction of movement of the opposite cylinder  
piston is reversed and both pistons move in the same direction  
from the rod ends toward the head ends of the respective cylinders,

25 and cut-off means operative to prevent discharge of fluid  
from the head end of the swing side cylinder as the swing post  
approaches a predetermined position relative to the swing side  
swing stop,

wherein the improvement comprises:

30 relief means bypassing the cut-off means to permit  
controlled discharge of fluid trapped in the swing side cylinder  
head end to cushion the deceleration of the swing post after the  
latter passes through the predetermined position.

and further conduit means routing the fluid from the  
35 relief means to the rod end of the swing side cylinder and to the

1 head end of the other cylinder whereby the other cylinder provides  
additional deceleration torque as long as no voiding occurs there-  
in upon the control valve means being returned to neutral before  
the swing post abuts its swing stop,

5 the fluid from the head end of the swing side cylinder  
providing the necessary volume of fluid to the other cylinder to  
prevent voiding.

4. A hydraulic system for actuating a swing post  
mounted backhoe according to Claim 2 or Claim 3 in which:  
10 the relationship of the pivotal connection of the  
hydraulic actuators to the vehicle frame and the swing post being  
such that the piston of the one actuator cylinder moves toward the  
head end of its cylinder substantially faster than the piston of  
the other actuator cylinder moves to the head end of its cylinder  
15 whereby return of the operating member to its neutral position  
prior to the completion of the swing post swinging movement cuts  
off pressurized fluid to the conduit means and results in the  
continued movement of the one actuator cylinder piston toward the  
head end of its cylinder by the momentum of the swinging backhoe,  
20 the movement of the one actuator cylinder piston creating  
a negative pressure in the conduit means and a reverse flow of  
fluid from the other actuator cylinder and a void in the cylinder  
between its piston and head end.

5. A hydraulic system for actuating a swing post  
25 mounted backhoe according to any one of Claims 2 to 4 in which  
the relief means for each hydraulic actuator communicates the  
head end of the one actuator cylinder with the first conduit  
means, and the head end of the other actuator cylinder with the  
second conduit means.

30 6. A hydraulic system for actuating a swing post  
mounted backhoe according to any one of Claims 1 to 5 in which:  
the relief means for each hydraulic actuator communicates  
the rod end and head end of each actuator cylinder through the  
piston means.

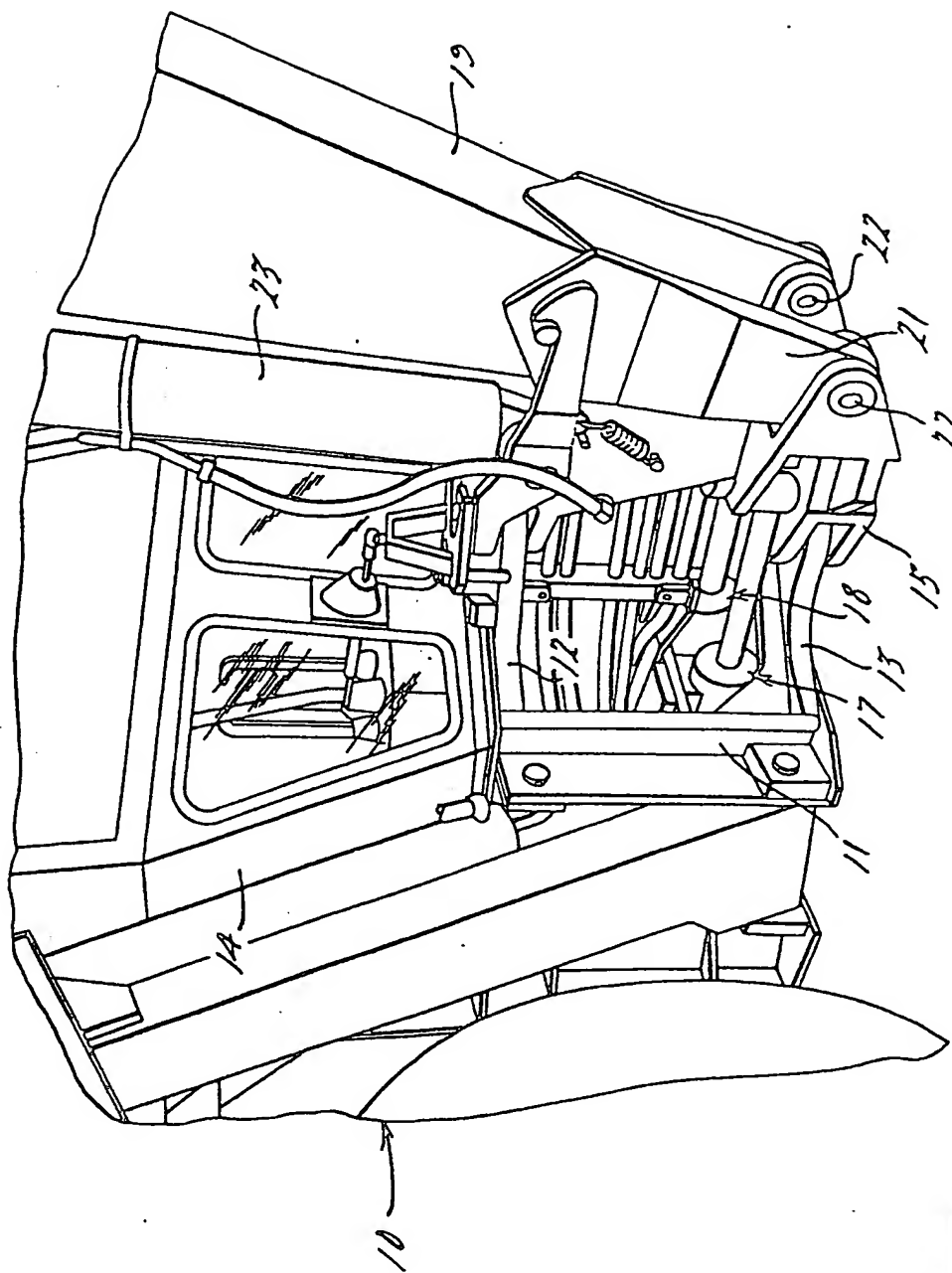


FIG. 1.

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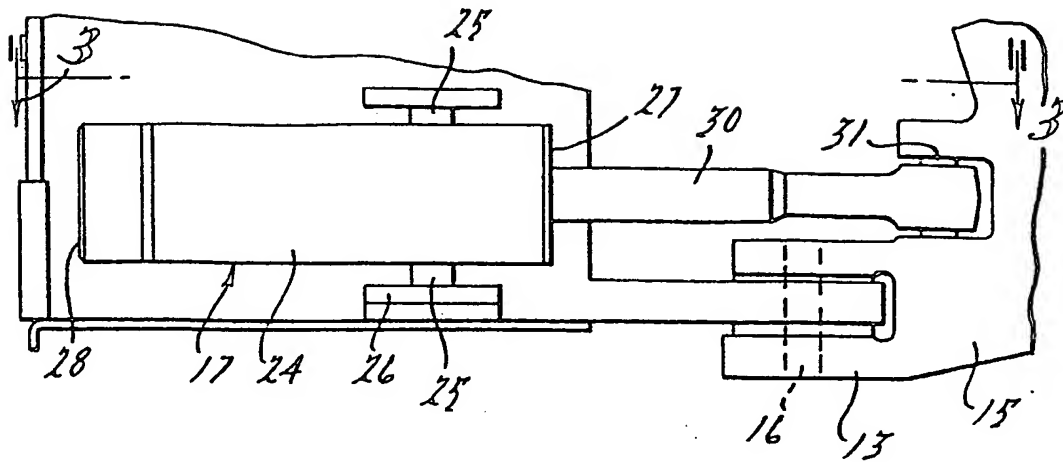


FIG. 2.

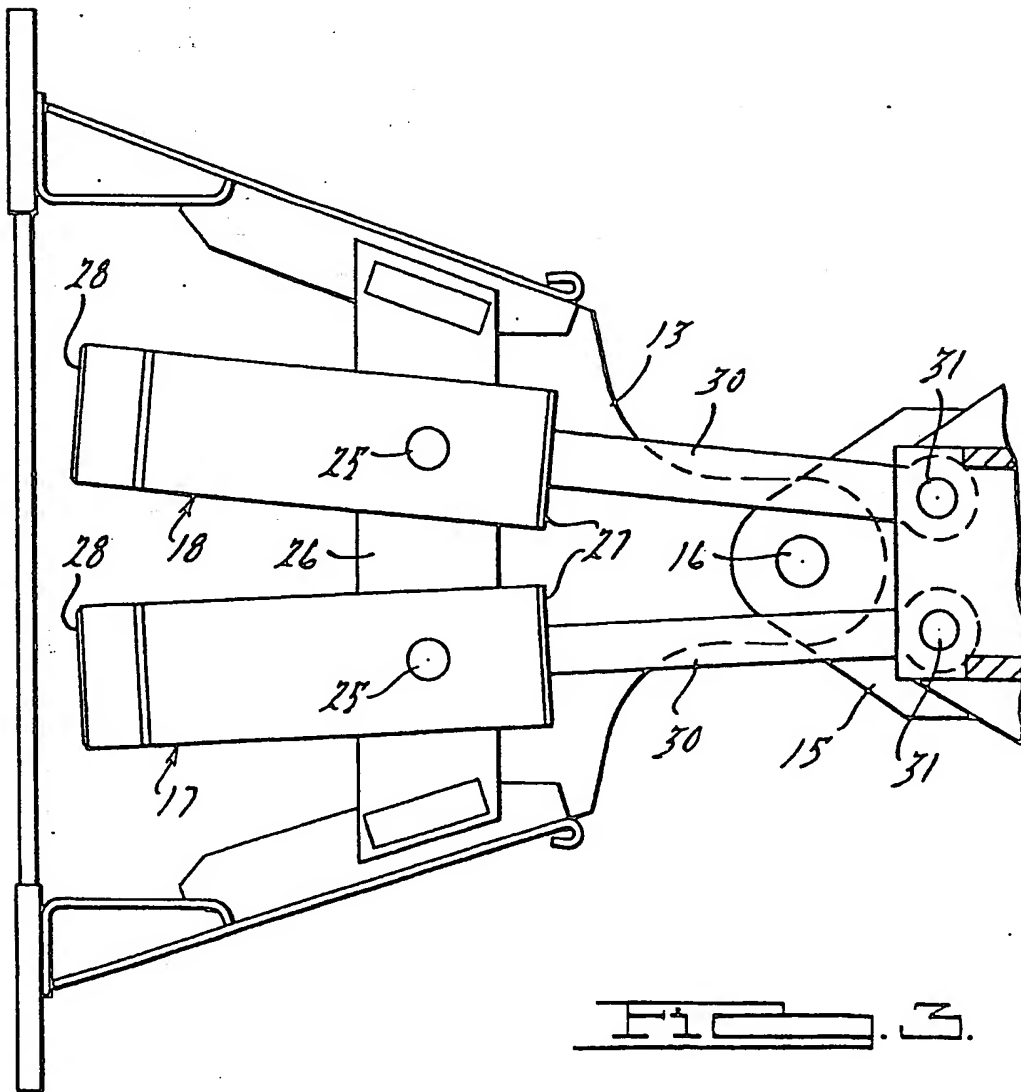


FIG. 3.



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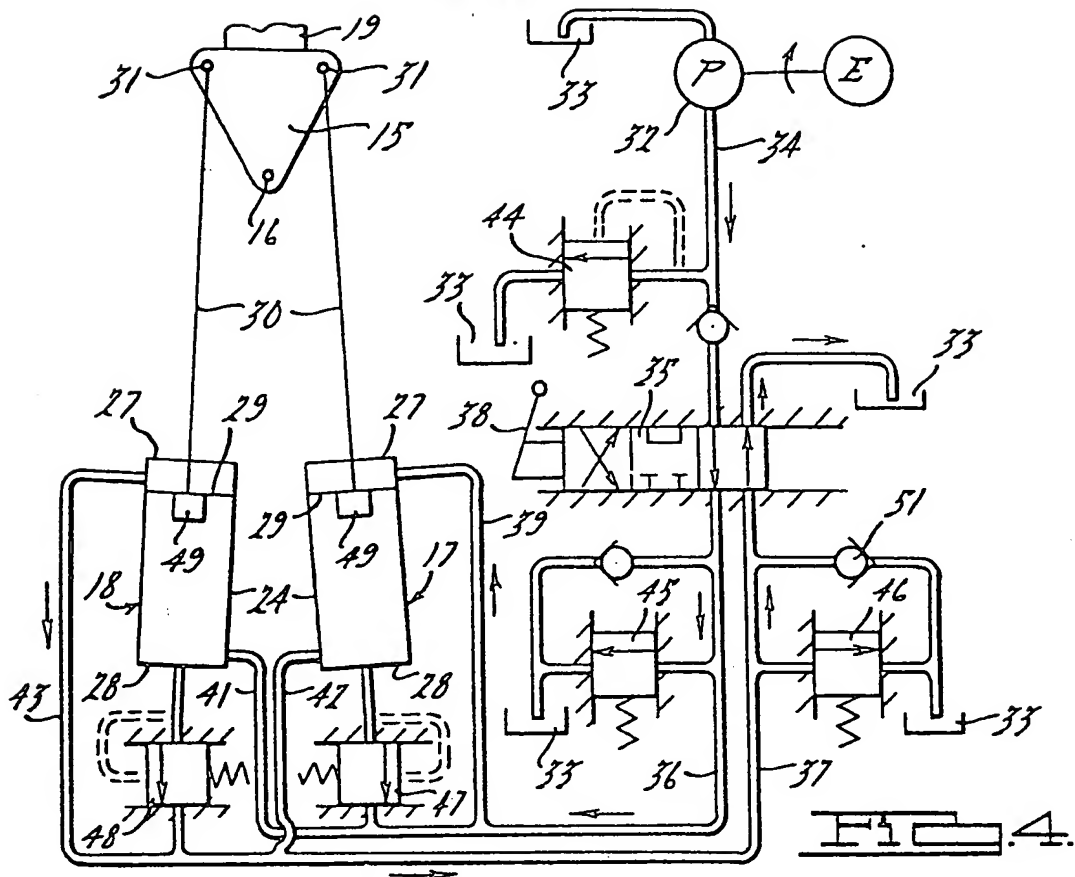


FIG. 4.

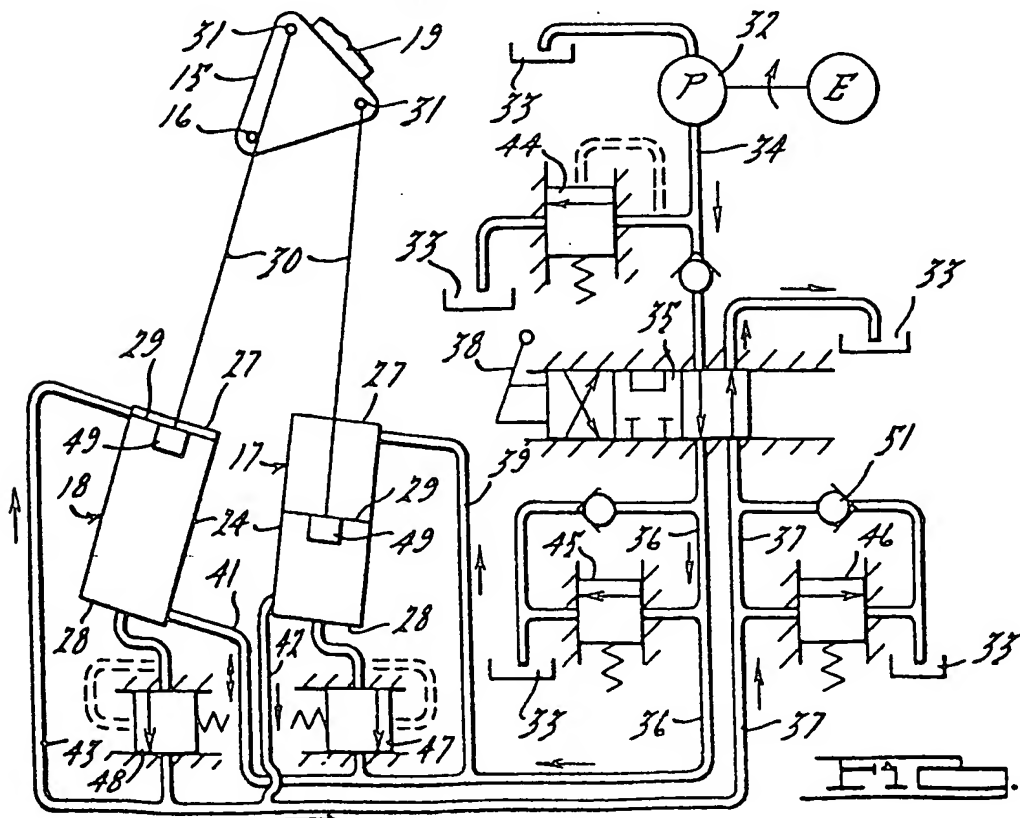
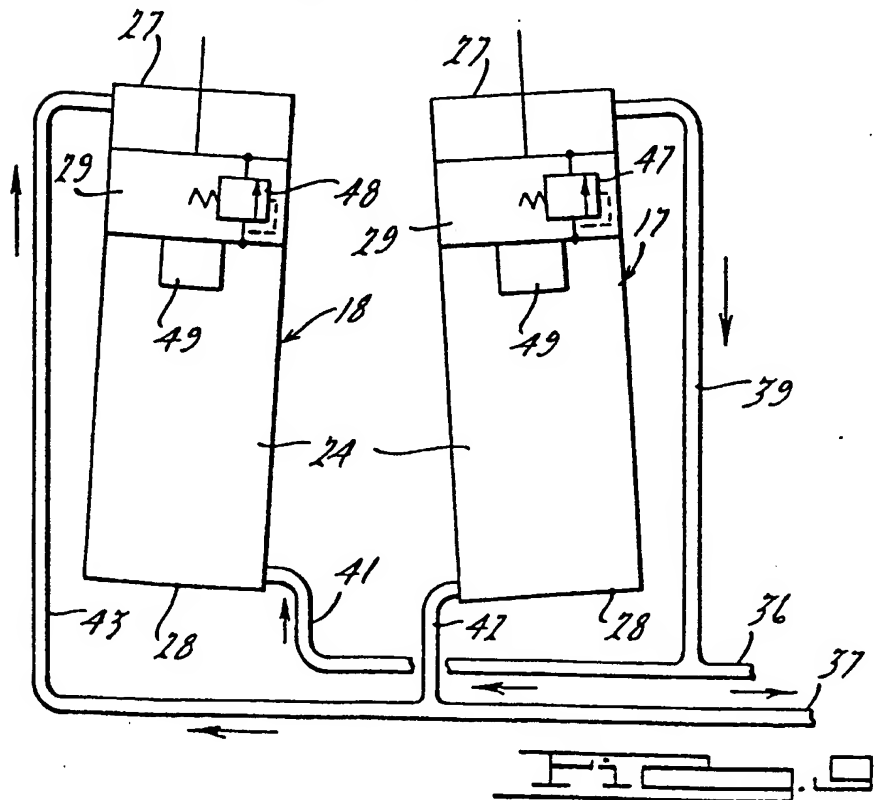
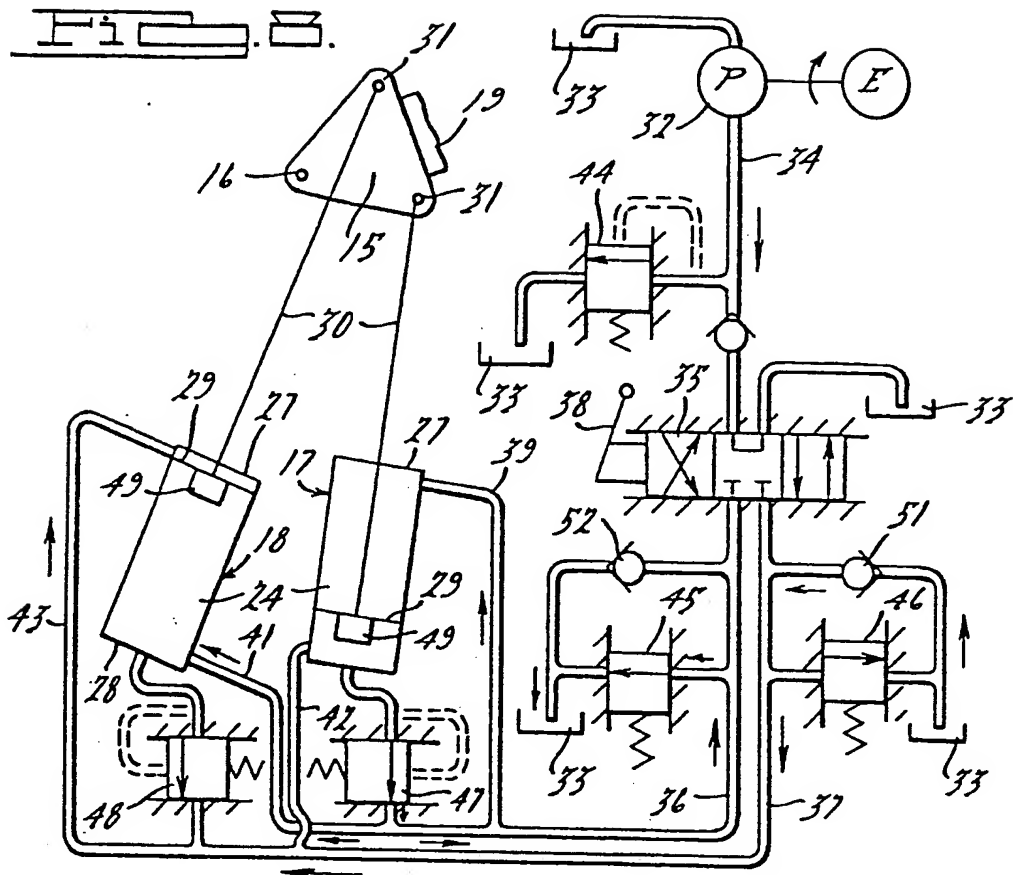


FIG. 5.





European Patent  
Office

# EUROPEAN SEARCH REPORT

0009974  
Application number

EP 79 30 2101

DOCUMENTS CONSIDERED TO BE RELEVANT			CLASSIFICATION OF THE APPLICATION (Int. Cl. <sup>1</sup> )
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	
X	<u>GB - A - 1 377 726 (VOLVO)</u> * Page 1, line 47 - page 2, line 25 *	1-3,5	E 02 F 3/32 F 15 B 15/06
	-- <u>US - A - 4 007 845 (MASSEY-FERGUSON)</u> * Column 3, line 63 - column 5, line 63; column 7, lines 11-50; column 8, line 60 - column 9, line 41 *	2-5	
	-- <u>GB - A - 1 297 236 (CASCADE)</u> * Claim 1 *	6	E 02 F F 15 B
			TECHNICAL FIELDS SEARCHED (Int. Cl. <sup>2</sup> )
			CATEGORY OF CITED DOCUMENTS
			X: particularly relevant A: technological background O: non-written disclosure P: intermediate document T: theory or principle underlying the invention E: conflicting application D: document cited in the application L: citation for other reasons
			&: member of the same patent family, corresponding document
The present search report has been drawn up for all claims			
Place of search	Date of completion of the search	Examiner	
The Hague	14-01-1980	PAUCNIK	

